

First of a Series on
NATURE MAGIC

NATURE MAGIC - INTRODUCTION

by

HARRIET SMITH
Raymond Foundation



Museum Stories, Number 219

October 6, 1951

Nature Magic

Has it sometimes seemed that nature is playing tricks on you? This series of stories explains some of the mysterious things in the world of nature—things that do look like magic.

You will find out what causes the weird lights that sometimes flash—

—in the sky:

Meteors Story 5

Polar lights Story 6

—in the air:

Fireflies Story 3

—deep in the swamp:

Glowing bacteria (tiny plants) Story 2

—or even under water:

Firefly squid and goosefish Story 2

Electric eel Story 4

You'll understand the disappearing acts of animals whose colors and patterns match their surroundings—

—The fawn's camouflage pattern of sunshine spots

—The weasel's season-matching change of coats

—The way some frogs and fishes can quickly change color ... All in Story 7

And you'll never again be fooled by masquerades of animals that imitate—

—another animal:

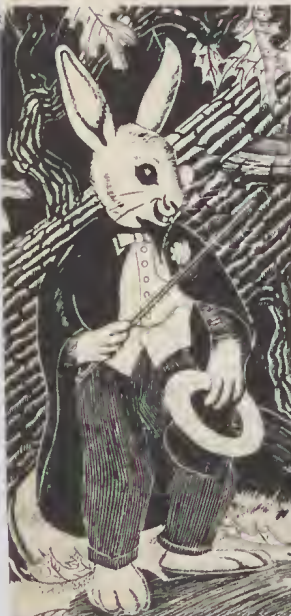
Viceroy butterfly

—or even a plant:

The twig-like walking stick

The leaf-like katydid

The measuring worm ... All in Story 8



Now all these strange tricks don't happen in nature just to deceive you. Most of nature's magic tricks performed by living things are ways in which the animal or plant species is protected, hidden from the eyes of an enemy seeking food. Other tricks are actually signal lights for animals to find each other or bait to attract food, while the electricity of an electric eel is a powerful weapon.

The dictionary defines "magic" as beliefs and practices that don't seem to operate according to the natural laws of cause and effect. Wouldn't it be easy, when there was something we didn't understand, just to say, "It's magic!" Long ago that's what people did think, but scientists, by experimenting in their laboratories and by observing the happenings in nature, are discovering more and more rules that explain how and often why nature performs its mysterious tricks.

We know, of course, that none of these tricks is magic because each of the strange occurrences called natural phenomena is in obedience to natural laws, just as the stars and the weather, with its thunder and lightning, behave according to the rules of chemistry and physics. Yes, the better man understands the world he lives in, the more he can imitate and control natural phenomena.

We have already learned how to make electricity and make it work for us—we can even make giant flashes of lightning. Yet some of nature's everyday wonders, like the firefly's living light, still keep their secret.



This page is for your own notes and illustrations

Second of a Series on
NATURE MAGIC

LIVING LIGHTS

by

LORAIN STEPHENS

Raymond Foundation



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October 13, 1951

Living Lights

One of the strangest forms of nature magic found in living creatures is the ability of certain plants and animals to give off their own light. This cold light is called luminescence.

The smallest creatures capable of producing light are called bacteria. They are tiny plants, so small that you cannot see one without the help of a microscope. There are many different kinds of bacteria. Some bacteria are harmful and cause disease, but most of them are harmless. About thirty kinds of bacteria produce their own light. Sometimes when fish are hung up to dry they glow mysteriously in the dark because they are covered with luminous bacteria.

The most brilliant displays of luminescence are seen in the water. At the surface of the water on dark nights during the summertime jellyfish, comb jellies, and other sea animals glow with this strange light. Even two thousand feet under the surface, where all trace of sunlight disappears, it is possible to see many animals. This is because some dwellers in the deep give off their own brilliant light. Sometimes the light is blue; sometimes it is silver, green, white, or red.

Many deep-sea squids are luminescent. The organs that produce the light are in various places on the bodies of the squid. Some squids even have them on their eyeballs. Firefly squids are among the best known and most often seen. In the evening hundreds of them often move toward the shores of Japan, as though attracted by the lights on land. Two large light organs are placed on the end of two of the squid's ten arms, and the rest of its body is dotted with light. Apparently a squid can produce light on different parts of its body at different times. No one is sure why squids have this ability. It might be to attract other animals in order to eat them, or to light the surrounding water to find food, or to recognize other squids.

Another luminous animal of deep waters is a kind of hermit crab. Since it is completely dark where the crab lives, the crab would be unable to see except for the fact that it carries a group of sea anemones on its back. Sea anemones are small flower-like animals, and these particular anemones are luminous. They act like headlights for the crab. In return for lighting the crab's way, the sea anemones get to eat the leftover particles from the hermit crab's meal.

One of the most unusual of animals is called the goosefish or angler. This fish has a huge mouth armed with long curving teeth. On the top of its head is a long rod with a glowing lump of flesh on the end that hangs down over its mouth. When the goosefish is hungry, it moves the rod and makes the lump on the end jerk up and down like a piece of bait. As soon as another fish sees this tempting-looking morsel shining through the water and swims up to investigate, the goosefish opens its mouth and devours the fish.

You may think that you have never seen luminous animals. Yet many people have discovered them in their own back yard, for on warm and humid summer evenings when the air is quiet it is hard to miss the flashing beacon of the firefly. Fireflies are our most familiar example of living light.



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Third of a series on
NATURE MAGIC

FIREFLIES

by

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Raymond Foundation



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Fireflies

Warm, damp summer evenings are the time of fireflies. Their living light is brighter than any kind of light that man has learned to make, and it doesn't cost anything. Nobody can tell you just how a firefly makes its small lamp work, but some of the facts that have been discovered about these mysterious insects may surprise you. Did you know that a firefly isn't a fly at all? It isn't a lightning bug either. It's a beetle.

When this insect sits still, its thin flying-wings are folded and hidden under the horny wing-covers all beetles wear. The lamp on the under side of its abdomen is hidden too and isn't usually lit up anyway except in flight. So you'd hardly guess—when you're chasing a firefly and it seems to disappear by magic—that the small brown beetle you have to look very hard to see on a plant stem is the same creature that was just making zig-zag sparks in the dark air.

When you know what to look for, it's easy to catch a firefly and put it in a glass. You'll see that the light doesn't shine all the time; the firefly can turn it off and on. Fireflies usually flash their lights while flying, but the females of some kinds have very tiny wings (or even no wings at all). Of course they can't fly; they can only crawl. So people call them glowworms. Most female fireflies in the western United States and in Europe are glowworms. You'd never suspect that they and the males are relatives.

You're much more apt to see fireflies east of the Rocky Mountains, for fifty of the sixty kinds found in the United States live in our moister eastern woodland region. The largest fire beetles, however, live in the tropics, where one kind of click beetle has such bright lamps that Spanish-American ladies tie the insects in their hair to sparkle at nighttime parties.

The different species of firefly in any area fly at different heights from the ground, flashing their lights with different time-spaces between signals. Some flash in blinks and others in long sparks. There are even some species in the Malay jungle that signal and answer all together in a two-part chorus of dancing lights. Thus each species has its own signal code, and a firefly will only answer the greeting of one of its own kind, for this signaling is the way the adult beetles court each other. But why do the larvae, pupae, and even the eggs of so many species—including the commonest kind here in Chicago—also glow?

The firefly's lamp is built much like any other lantern, with a reflector (the outside layer of whitish cells), a fuel chamber (large, sac-like cells containing a secret fuel manufactured by the firefly), and a means of supplying the oxygen needed to burn this fuel (many air tubes from the outside to the lamp cells). When oxygen is let into the lamp, it burns the living fuel, producing a greenish, almost cold light. Yet when we burn something we expect to get a lot more heat than light! An electric light bulb doesn't glow until the metal wire inside has been heated white-hot (is incandescent). This gives a hundred times more heat than light, while a firefly produces a hundred times more light than heat.

The firefly has another very great advantage. It can use the same fuel over and over. While the oxygen supply is shut off and the lamp is out, the burned material changes into fuel again. This is like being able to change ashes and cinders back into coal.

No wonder lighting engineers wish they could discover the secret of the firefly's lamp, eight thousand times as efficient as an electric light bulb. The sort of light that only fireflies and a few other animals and plants can manufacture is the only known light that isn't mainly heat. Man-made lights shine from burning up dead fuel, but this is living light.

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Fourth of a Series on
NATURE MAGIC

THE ELECTRIC EEL

by

LORAIN STEPHENS

Raymond Foundation



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The Electric Eel

Every day you probably do many things that would have seemed like magic to your great grandparents. For example, you walk into a dark room at night and, with a flick of your finger, the room is as light as it is in the middle of the day. Or you lift up the telephone receiver and in a few seconds you are talking with a friend who may be many miles away. You are able to perform this "magic" because of electricity.

Electricity has been a force on the earth since the earth was formed. Probably prehistoric men cowered in their caves when lightning flashed, for it has only been during the past two hundred years that we have learned to use electricity. But even though it took man a long time to understand electricity, some animals have been utilizing it for thousands of years.

In the muddy, sluggish waters of the Amazon River lives a strange fish. Its long cylindrical body moves slowly along the bottom of the river-edge. It swims



close to a school of small fishes feeding near-by and suddenly several of the fishes turn on their backs and start to float to the surface. They are dead. The larger fish moves in and begins to eat. To an observer

this strange action would appear to be magic because the large fish killed the smaller ones without touching them. It was able to do this by using electricity, for this fish is the electric eel.

If you were to visit the zoo in Para, Brazil, you would see a pool of water near the main building with a sign of warning close by: "Cuidade! Puraques" (Beware! Electric Eels). The people of Brazil are afraid of electric eels and are always careful about wading in water where they may be found. In the long tail of the electric eel are three pairs of electric organs that are amazingly powerful. The eel can use them to send out a charge of three or four hundred volts, enough to paralyze a man temporarily or even an animal the size of a horse. When people want to study one of these eels they must wear rubber gloves in order to handle it safely. People have been killed by coming in contact with eels in the water. Probably death was not caused by the shock itself but by drowning after the shock had paralyzed the victims.

The electric eel uses this power to protect itself and to kill its prey. It may grow to be six or seven feet long, and most of its length is used by its long electric organs. The eyes of the eel are very small and are crowded toward the front of its head. Often eels are completely blind, which may be a result of the electricity. However, the water where the eels live is usually very muddy, and so they would probably use their eyes very little anyway.

There are several other kinds of electric fishes. One of these is the electric catfish, whose power has been known to the Egyptians for thousands of years. The name of the electric cat fish appears in the picture writing found in ancient Egyptian tombs. Even though man's knowledge of electric animals goes back many years, the secret of their ability has not yet been completely discovered, and electric animals still remain something of a mystery.

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Fifth of a Series on
NATURE MAGIC

VISITORS FROM SPACE

by

ANNE STROMQUIST

Raymond Foundation



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Visitors From Space

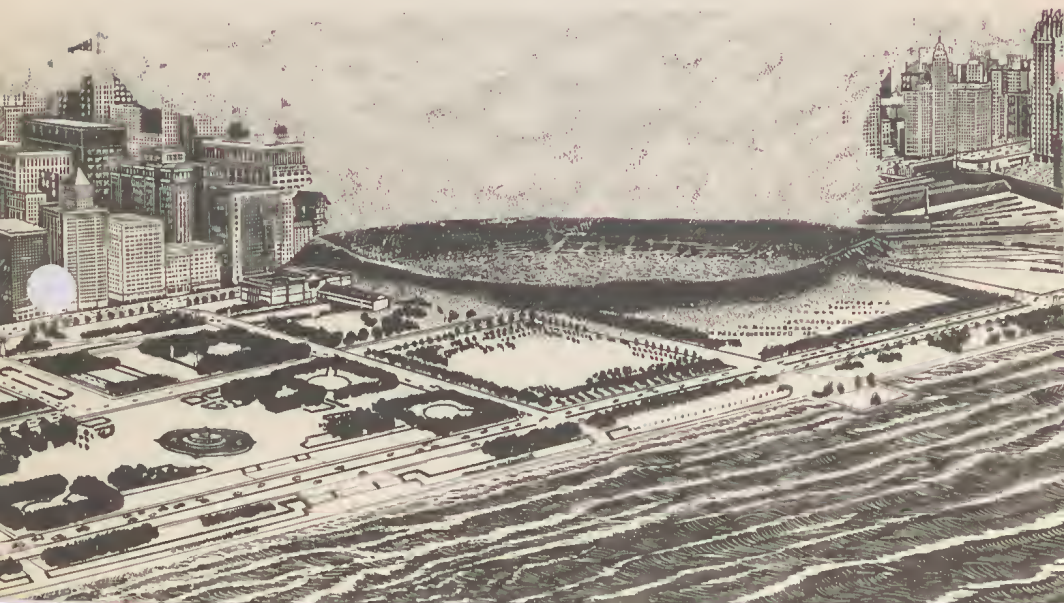
The biggest show that can be seen anywhere charges no admission. Its wonderful stage is the sky and the endless space of the universe and whatever lies beyond. If you look up at the sky on a clear night, there will seem to be thousands of twinkling lights hanging in space. For every one you can see there are millions too small to be seen. Many of these could be seen with a telescope, but it is believed many more are so far away that the biggest telescope in the world can't make them visible.

Once in a while a star will seem to detach itself from its place in the sky and rush down to earth with a bright luminous tail streaming behind. This shooting star is known as a meteor. A meteor is the only thing from outer space that ever falls down to our earth so that we can actually touch and study it. Once it has fallen to the earth it is called a meteorite.

By studying these visitors from space, scientists can tell a lot about them. They know the meteorites are made of heavy stony matter or of nickel-iron alloys similar to certain rocks we have on our own earth. Scientists also know that the meteorites are parts of broken up astral bodies such as planets or comets. There is a belt of such small bodies revolving around the sun between Jupiter and Mars, just like planets. Scientists think there was once a planet between Jupiter and Mars that came too close to Jupiter and was completely shattered by its great pull of gravity. Gravity is the force that pulls you back to the earth when you jump into the air. When the earth goes near this belt of asteroids or through a comet's tail we have a meteor shower and so it is thought that meteors are pieces of comets or broken planets. If you look at or touch a meteorite, you'll see that it is stony or metallic, and different from the wonderful glowing meteor it was during its air travels. We know how the meteorite goes through this magic transformation.

Meteors travel through space at tremendous speeds, sometimes as great as forty-four miles per second. If you could go as fast, you could get from New York to San Francisco in about a minute. At such a terrific speed the friction or rubbing of the meteor against the air raises the temperature of the surface of the meteor so high that the meteor becomes white-hot and begins to burn, just as two pieces of wood begin to burn or smoke when they are rubbed together. The outside of the meteor actually melts, although it is made of stone or iron, and the melted matter is blown back to form a bright tail or streamer.

Most meteors are fairly small or so small that they completely burn up before they reach the earth's surface, but there have been a few tremendous ones that have fallen down to earth. One of the most famous fell at Canyon Diablo, or Meteor Crater, in Arizona. This meteor, which weighed about one million tons, exploded when it hit the earth and only fragments of it have been found; but the great crater it made is about 570 feet deep and three-quarters of a mile wide. It was not the biggest meteor ever to have fallen to earth. Yet if such a meteor should fall on Chicago, its terrific impact would cause much more destruction and damage than an atom bomb.



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Sixth of a Series on
NATURE MAGIC

MAGIC SKY LIGHTS

by

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Magic Sky Lights

Since ancient times, people in many parts of the world have seen strange lights appear magically in the sky. Most people have seen them in the northern parts of the world and so they are usually called northern lights or aurora borealis. The lights also appear in the southern regions, where they are known as southern lights or aurora australis.

These lights appear in different colors, such as white, pink, red, green, and yellow. They may take strange shapes in the sky. They may take the form of a great rainbow-like arc. They may appear as bands, or rays, or filmy curtains, fold upon fold in the sky. They may appear simply as a soft glow, or as a patch of light in the sky, or as a corona that looks like a burst of rays from a center point. Long before scientists discovered what caused these lights people were often terrified by them and very superstitious about them. Some believed that great armies warred in the sky and that heaven itself finally caught fire and burned. Today we know it is the bright, yellow, shining sun that causes the aurora.

To us the sun seems warm and friendly, but it is really a terrifying mass of energy. We know this energy as the sun's heat and light. People can get really bad burns on their bodies if they stay in the sun for a long time, and they can be blinded by the sun's rays if they look right into it. Yet only a very small part of the sun's energy reaches the earth. It would take a candle twenty times the size of the earth to give as bright a light as the sun.

Sometimes the surface of the sun is swept by terrible raging storms that are called sunspots. During these storms tiny particles shoot out of the sun millions of miles into space and touch our earth. When this happens our radio, telephone, and telegraph systems of communication are often made useless and we can do

nothing about it. These particles, too small to be seen under a microscope, spout in streams from the sun like water being sprayed out of a gigantic fountain. They travel a thousand miles a second. At such a speed you could get from Chicago to New York before you could say Jiminy Cricket! The particles themselves do not reach the earth's surface. There is a sort of envelope around the earth protecting it from these speedy rays. This invisible envelope is formed by a magnetic field of force like the unseen field around a magnet that will pull objects to the magnet and hold them there. The magnetic field around the earth pulls most of the sun's particles to the polar regions.

When the sun's particles reach the upper part of our atmosphere they bump into the particles that make up our air. This causes the air particles, or atoms, to glow. When many of these air atoms are made to glow at one time, the light can be seen from the earth's surface below. This light sometimes seems to touch the earth but it actually occurs at least sixty miles or more above the earth's surface.

Today scientists know what causes the auroras and can even predict them, for the lights seem to occur most often every eleven years. We know they occur most often in March and September and sometimes last for as long as from five to twelve months.

Perhaps someday men will learn how to harness this energy from the sun and how to make it useful. Even if they don't, the aurora will remain the most beautiful of all sights in the night sky.



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Seventh of a Series on
NATURE MAGIC

DISAPPEARANCE

by

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Raymond Foundation



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November 17, 1951

Disappearance

While I was walking along the bank of a stream several months ago, a piece of moss jumped right into the water. I looked closely, and then I saw that the moss was really a leopard frog. Have you ever been startled by a little, green, harmless frog?

How amazing that a small frog could be mistaken for just a piece of moss! The leopard frog is green with brown or green spots and two light yellow stripes down its back. These colors protect the frog because they make it look very much like the surroundings, and so its enemies have a hard time seeing it. When this frog jumped from under my foot into the water, it changed its color quickly from dark green to the pale olive of the pond. A leopard frog often wanders far away from water. If you catch one and put it in your sand pile or on some rocks, you would think that it could easily be seen. However, you will be very surprised at what happens. The green parts of this frog will change to a slate-gray so that now it is the same color as the sand or the rocks.

There is a kind of fish, called the flounder, that can change into many more color-patterns than the frog. This fish is very flat, with both eyes on the same side of its head. When it rests on a part of the ocean floor that is covered with pebbles, the colors of its back change so that the flounder looks like the pebbles. Or if it swims into a place where the bottom is very dark, its colors change so that fish and floor blend together. It is known that a flounder changes its color through its eyes. If it is blind, its colors do not change. The flounder then becomes colorless all over, like its underside.

I imagine that a lot of you have seen a weasel or heard about it. The weasel has a slim little body with short legs. In northern Wisconsin the weasel changes color. All summer it has a dark brown coat with

yellowish-white fur underneath. However, with the approach of winter a few white hairs appear on its tail and head. The number of white hairs increases rapidly until the fur has a curious salt-and-pepper color. Finally after three to five weeks the brown hairs completely disappear, and the weasel is all white except for the tip of its tail, which is black.

Now this change to white does not depend on whether or not there is any snow lying on the ground because many weasels are all white before the first snowfall. This white color guards the weasel. It not only protects the weasel from enemies but also helps it to catch food because the weasel matches the snow. We know this white fur as ermine. In fairy stories you have read about the ermine robes that kings wore. Well, from this white winter coat of the weasel come the robes of kings and the very wealthy.

Early in March a few brown hairs reappear in the white fur. When the tree buds swell in April, the weasel has again put on its summer coat of brown. Our weasels in Illinois do not change to an all-white ermine coat because our winters are not cold enough. Our weasels just turn a lighter brown in the winter.



The white spots of a fawn help to protect it

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Eighth of a Series on

NATURE MAGIC

ANIMALS IN DISGUISE

by

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Raymond Foundation



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November 24, 1951

Animals In Disguise

Last summer I found a twig on my screen door. It seemed a very strange place for a little green stick to be caught. However, several hours later this twig had moved from one side of the screen to the other. Of course, you know this wasn't a twig at all. It was an insect—the walking stick!

The walking stick is protected by its shape and color. It is about four inches long, and its body is slender with long, angular legs. The walking stick changes color, like a growing twig, from green to grayish brown. Since it mimics (looks like) twigs, it probably is protected from its enemies.

This disguise of the walking stick is very bewildering because you can see the insect but you think that it is part of a plant or tree. You are apt to pass the walking stick by, unless it moves. It walks about in a very slow, awkward manner. Usually you can only tell that the walking stick is not a twig when it is found away from plants or trees. To detect the walking stick takes very sharp eyes.

Another kind of insect that looks like a twig is the measuring worm. It is the caterpillar of a moth. The measuring worm has only two pairs of legs, one pair at each end of its body so that it can't crawl like other caterpillars that have three pairs of legs. When the measuring worm crawls, it must draw the back end of its body up to the front, extend its body while it holds on to the leaf or branch with its hind legs, then draw its hind legs up again, and so on. As it crawls along, the caterpillar looks as if it is measuring the branch. That's how it got its name. When the measuring worm is alarmed, it remains motionless, clinging to the stem with its hind legs and holding its long lumpy body in the air so that it looks like a stick. These two insects can disappear by becoming stem-like whenever the need arises.



*Can you tell the viceroy
from the monarch butterfly?*

There are many animals that to protect themselves imitate either something in their environment or some other animal that is inedible. Like the walking stick and the measuring worm, the katydid is another insect that copies. Instead of looking like a twig the katydid has two finely veined wing-covers that look like two leaves, so that when this insect is resting in a bush you can't tell it from a leaf. A pair of wings is folded like fans under these wing-covers. Its leaf-like wings are in form and color so similar to leaves that

the katydid is completely hidden when it is in a bush or tree. The katydid is not discovered very often because it looks like two very uninteresting leaves instead of a live animal.

You know what the monarch butterfly looks like, don't you? The monarch, an orange and black butterfly, is found in Chicago all summer long. Some people believe that its color-pattern advertises to all birds that here is a disagreeable-tasting insect and that it should be left alone.

The viceroy butterfly looks very much like the monarch in color and markings. Nevertheless, you can tell the difference between them easily because the viceroy has a black band on the hind wings and the monarch does not have one.

The story goes that viceroys are a tasty meal for a bird. But when birds see the viceroy they mistake it for the evil-tasting monarch butterfly, and so the bad taste of the monarch protects the viceroy butterfly. If this is true, it is an interesting case of mimicry.

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